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ALTERNATIVE MEASURED-SERVICE RATE STRUCTURES FOR LOCAL TELEPHON--ETC(U)
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Bridger M. Mitchell

June 1980

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FOR LOCAL TELEPHONE SERVICE*

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INTRODUCTION

Local telephone calls are undoubtedly the most frequently used utility service that is sold at a zero price in the United States. For residential telephone users the cost of this service has traditionally been supported by a flat monthly subscription fee and by revenue transfers from business subscribers and the sale of long-distance calls.

A priori, one might expect such a system to cause a significant loss of economic welfare in a market of one billion residential local calls a month costing perhaps $350 million annually. But demand has generally been thought to be very price-inelastic and prior to the advent of electronic switching the transaction costs of measuring and billing each call was substantial. Thus the lack of a per-unit charge for a local residential call could be welfare-optimal, as suggested by a model based on limited empirical data (Mitchell 1978).**

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*Forthcoming in M. A. Crew (ed.), Issues in Public Utility Pricing and Regulation, Lexington Books, Cambridge, Mass. Ed Park has stimulated me to think more deeply about the issues raised here and saved me from several errors. I also thank Michael Crew and John Panzar for helpful comments. This paper is based on research supported by National Science Foundation, grant DAR 77-16286 to The Rand Corporation.

**Measuring costs depend strongly on the technology of the telephone network. Many European telephone administrations use a low-cost method of charging for local as well as long-distance calls, measuring usage with periodic pulses whose frequency varies inversely with the price per minute of calling. Each subscriber's monthly usage, in pulse units, is accumulated by a separate meter and billed as a summary amount (see Mitchell 1979b, 1979c).

As electronic technology--stored program control and digital switching--replaces electromechanical central office equipment in the local telephone network, call measurement costs are expected to decline substantially. The major telephone companies have begun to embrace a new pricing approach--termed usage-sensitive pricing or local measured service--that would charge customers for each outgoing call that they place, and in its more elaborate forms for the duration and distance of the call and the time of day at which it is made.

This paper examines several types of measured-service rate structures that could eventually supplant the ubiquitous flat rate and analyzes in detail the effects of offering consumers a choice between a flat and a measured rate. New rate structures could cause large changes in some subscribers' bills, and a transition to measured rates might be designed to spread this impact over several years. Ignoring these redistributive issues, the analysis here concentrates on the long-term welfare effects, implicitly measured by consumers' plus producer's surplus, of alternative rates. To highlight these effects simple assumptions are made: costs vary only with the number of subscribers and calls, and the detailed effects of consumer demand elasticities ("repression") are omitted. Although a more elaborate model would provide increased realism, it would not qualitatively change the basic results.

Cost Structures

The total costs of supplying local telephone calls are assumed to depend linearly on the number of subscribers, n, and the total number of calls, x:

(1) $$C = C(n,x) = F + C_A n + C_U x$$

These costs are long-run in nature, reflecting the local plant required to supply access lines and the trunking and switching capacity needed to meet busy-hour demands. If measured rates are charged, total costs are increased by the costs of measuring and billing usage

(2) $$C_M = C_{MA}\, n_M + C_{MU}\, x_M$$

which are also assumed to vary linearly with the number of customers billed under measured rates, n_M, and their total number of calls, x_M.

This basic cost function abstracts from the effects of variations in call duration and distance and varying utilization of capacity at different times of day. It also assumes that the joint supply of local calls and others services--principally long distance calls--does not create an important difficulty in estimating the marginal cost of access, C_A, and usage, C_U. A recent Bell System study indicates that these long-run marginal costs, in 1975 dollars, were approximately \$11 per month per additional subscriber and 3¢ per call (Rohlfs 1979, Mitchell 1979a).

The fixed costs incurred to provide local service may well depend on what other telephone services are supplied. For this paper the amount F can be considered a revenue or contribution requirement. In practice, its value will depend importantly on cost

allocation procedures used to "separate" costs between local and long distance services.*

ALTERNATIVE RATE STRUCTURES

The rate structure for local calls is summarized by the subscriber's outlay function R(x) which gives the total expenditure required to purchase x calls per month.** Several basic types of rate structures are shown in Fig. 1.

A flat rate

(3) $$R(x) = FR = \text{constant}$$

has been the predominant rate structure for U.S. residential customers.

A two-part rate or measured rate (MR)

(4) $$R(x) = p + qx$$

charges a monthly price p for access to the telephone network (to both place and receive calls) and a price q per outgoing call.

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*Currently, the residential contribution F may be negative in some jurisdictions where high long-distance and business subscription rates have provided large revenue transfers to reduce local residential rates. But in the longer term the supply of long-distance services by competing common carriers using microwave and earth satellite transmission facilities is expected to reduce sharply the revenues available to support local services. In accord with the long-run perspective of this paper I assume that F is non-negative.

**In addition, there is a one-time service connection fee.

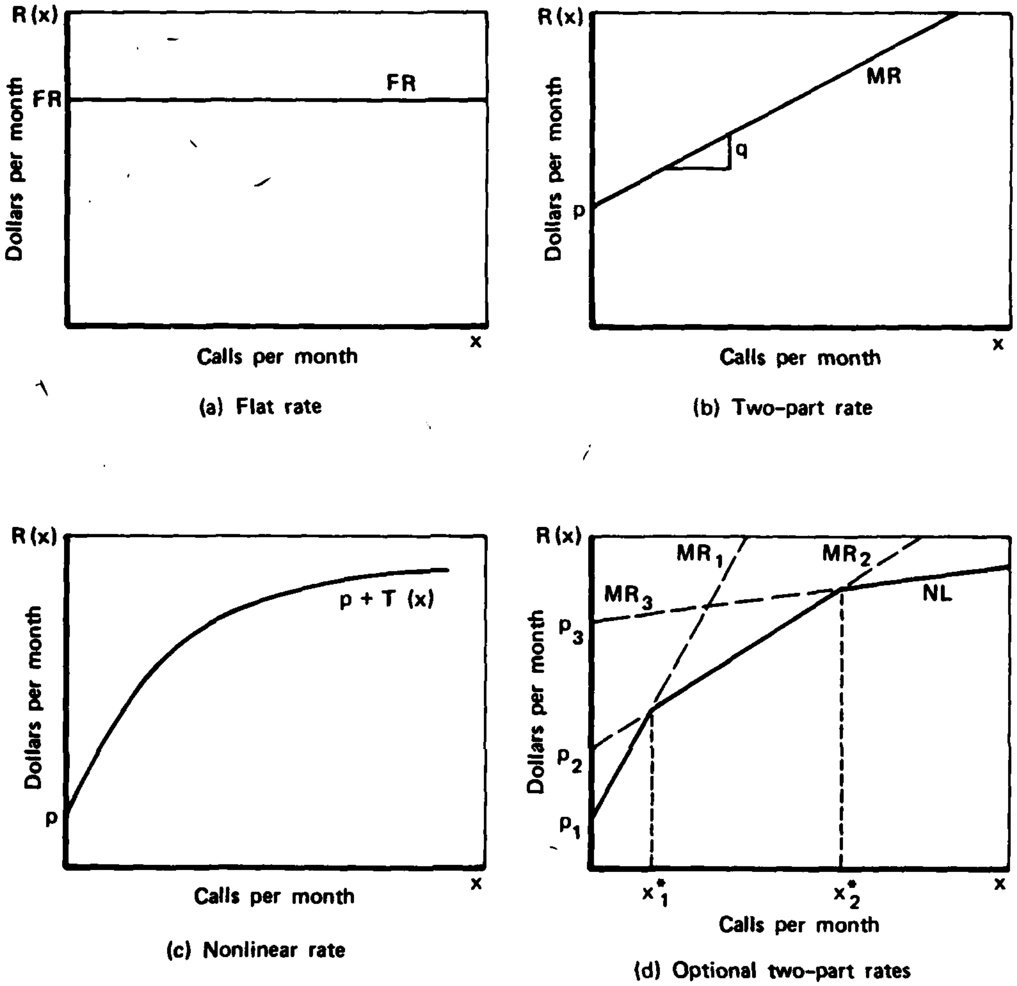

Fig. 1 — Alternative rate structures

A <u>non-linear rate</u>

(5) $$R(x) = p + T(x)$$

also charges an access price p plus an amount T(x) that varies, but not in direct proportion to the volume of calling. Usually, as shown in Fig. 1c, nonlinear rates are concave functions that provide volume discounts for larger consumption.

Optional two-part rates permit the subscriber to minimize his monthly bill by choosing from among several rates with different access prices p_i and usage prices q_i. For example, suppose three rate plans are offered with $p_1 < p_2 < p_3$ and $q_1 > q_2 > q_3$. Then the bill-minimizing rates correspond to the solid curve in Fig. 1d. The "breakpoints" x_i^* are the quantities at which two rate plans have the same monthly bill.

Demand for Calls

An individual consumer, with tastes indexed by the parameter θ, may be assumed to possess a utility function $U_\theta(x_\theta, y_\theta - R(x_\theta), n)$ where x_θ is the number of telephone calls, y_θ is income and $y_\theta - R(x_\theta)$ is expenditure on other goods, and n is the number of telephone subscribers. The consumer's demand for telephone calls can be derived from his two interrelated decisions--deciding whether to subscribe to telephone service and determining the number of calls to make if he subscribes (Littlechild 1975, Mitchell 1978). These relationships, aggregated over the joint distribution of consumers' preferences and incomes, permit the interdependent market demand curves for access (n) and volume of calls (x) to be derived. For a particular rate structure, these demands determine revenue, cost and profit. In a regulated setting profit (π) may be constrained to be zero, or alternatively to be a specified negative value $-\pi_0$ if only a portion of the assigned fixed and overhead costs F are to be recovered by local rates.

Second-Best Pricing

In the context of the assumed cost function (1), marginal-cost pricing amounts to charging the two-part measured service rate

$$\text{(6)} \qquad MR = C_A + C_U x.$$

In the case of telephone service, achievement of the ideal efficiency effects of marginal-cost pricing is limited by several factors.

First, as noted above, measuring equipment requires added investments, and monthly billing operations increase expenses. The appropriate marginal-cost rate will include these costs

$$\text{(7)} \qquad MR = C'_A + C'_U x$$

where $C'_A = C_A + C_{MA}$ and $C'_U = C_U + C_{MU}$. Unless these extra resources return significant economies in the use of the telephone system, a simpler flat-rate price structure is preferable.

Second, membership in the telephone network usually creates a positive economic externality. The value to an individual consumer of being connected to the telephone network is increased when other consumers are also connected. As a result, the total value to society of an additional subscriber is greater than just the private value that he places on telephone service. Economic welfare may be increased by pricing access to the telephone network at something less than its marginal cost and by increasing other rates to subsidize the access service.

Finally, marginal-cost pricing would cause a deficit for a telephone company with economies of scale and scope; a zero-profit constraint requires that some prices exceed marginal cost.

"Second-best" prices maximize social welfare subject to one or more constraints. The prototype problem is maximization of consumers' plus producer's surplus subject to a minimum profit constraint. When the market for the firm's services can be segmented into separate and independent demands, the optimal prices are given by the Ramsey principle: increase the price of each service over its marginal cost in inverse proportion to its elasticity of demand (Ramsey 1927; Baumol and Bradford 1970).

Second-best rates may be considered in terms of each of the rate structures of Fig. 1. Under a flat rate (Fig. 1a) there is only one price.* To satisfy the budget constraint it must be equal to average cost; equivalently, the flat rate equals a pro-rata share of fixed costs plus the marginal cost of access and the average cost of usage:

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*However, if the market can be segmented, there is room for welfare-increasing price discrimination. The traditionally lower flat rates charged to residential subscribers are consistent with their higher elasticity of demand, although the levels of the rates do not necessarily correspond to those of the Ramsey formula (see Mitchell 1976).

Some of the difference between business and residential flat rates is also attributable to higher average levels of calling (and therefore higher costs) for business subscribers. It would, of course, be possible to discriminate between business and residential customers under measured-service rate structures as well. But because measured service rates will automatically vary with usage costs, there is less need to have separate rates by class of customer. I will assume a single rate structure applies for both business and residential service.

(8) $$FR = (F + nC_A + C_U \Sigma x)/n$$

$$= F/n + C_A + C_U \bar{x}$$

The two-part rate structure (Fig. 1b) permits each call to be priced at marginal cost, $q = C'_U$, and would therefore seem to provide the first-best pricing solution (if measuring costs are sufficiently small):

(9) $$MR = p + qx = (F/n + C'_A) + C'_U x.$$

But if demand for access to the local network is at all price-elastic this access price will exclude some potential subscriber i who is willing to pay his marginal costs $C'_A + C'_U x_i$. In general, it will increase welfare to set $q > C'_U$ in order to lower p somewhat. The second-best two-part rate structure will most likely require setting both the access price, p, and the usage price, q, above marginal costs (Ng and Weisser 1974).* If customers can be segmented by differences in their demand elasticities, these markups above marginal costs will vary inversely with demand elasticities according to a generalization of the Ramsey formula that accounts for interdependence between the demand for access and the demand for calls (see Mitchell 1978). However, if network externalities are sufficiently large, it may even be optimal to price access below marginal cost.

*However, this relationship need not hold if consumers with differing tastes have intersecting demand curves. Cf. Oi (1971).

A nonlinear rate structure (Fig. 1c) allows the firm to discriminate among customers according to volume of consumption ("size") and thus to achieve greater welfare gains than are possible under a two-part rate. So long as local telephone calls are not readily resold, the firm can collect more revenues from some groups of consumers and use them to set a lower access price than under a two-part rate. In general, in the optimal nonlinear rate structure the marginal price of an additional call $R'(x) = dR(x)/dx$ will exceed marginal cost for all but the largest quantity, x_{max}, at which point $R'(x)$ should just equal marginal cost (Willig 1978).

Optional two-part rates (Fig. 1d) allow the customer to choose from among several measured rate plans. In advance of consumption he selects the one under which he will be billed. If he knows his demand <u>with certainty</u>, optional rates will provide a piecewise linear approximation to a nonlinear rate structure (Faulhaber and Panzar 1977). Thus, in Fig. 1d the three optional rates MR_1, MR_2 and MR_3 are equivalent to the nonlinear rate structure NL shown by the solid line. In this case, a sufficient variety of suitably designed options can provide almost all of the welfare gains of a nonlinear rate schedule.

Typically, however, a consumer's calling rate is somewhat uncertain. Furthermore, the number of calls he makes may also vary systematically from month to month. These factors mean that the consumer who must choose one rate plan in advance and be billed under it for several months will tend to have higher payments than would result under the "equivalent" nonlinear or piecewise-linear rate schedule. For example, consider the consumer who makes x_1

calls in the first month and x_2 the next month, for an average calling rate of $\bar{x}$. If he must choose one of the two optional rate schedules shown in Fig. 2, the lowest overall bill is obtained under MR_2. He pays monthly charges of R_1 and R_2 for an average of $\bar{R}$. If the consumer could instead select a separate rate schedule for each month he would pay only R_1' and R_2, reducing average charges to $\tilde{R}$.

Will second-best measured-service rate structures necessarily improve welfare? If consumer demand curves are linear, and there are no network externalities, a two-part measured-service rate increases net welfare so long as the cost savings from reduced usage are more than twice the measuring costs (Mitchell 1979a). By lowering

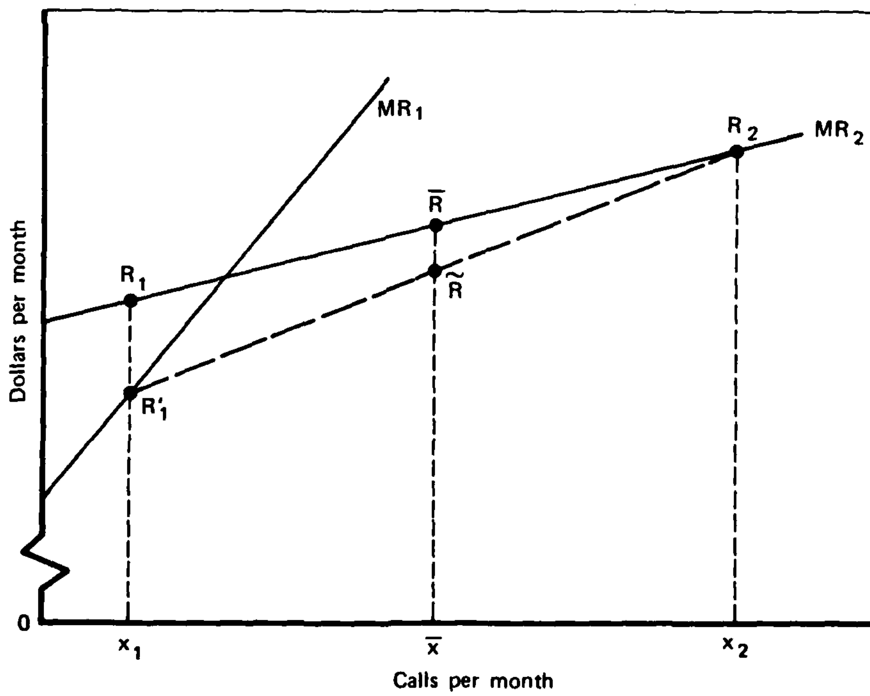

Fig. 2 — Average bills under optional and nonlinear rates

the price of access to the network and increasing the number of subscribers, nonlinear and optional rate structures will provide somewhat larger net welfare gains.

However, measuring costs per call may be large enough to make mandatory measured-service rates undesirable. In these instances is it possible to achieve net welfare gains by metering only some subscribers?

OPTIONAL FLAT AND MEASURED RATES

If measured service is offered as an option to a flat rate, this reduces the resources devoted to measuring, but it also limits any welfare gains from positive per-unit pricing to a subgroup of the market. If measuring costs must be incurred for all subscribers, then any of the second-best measured-service rate structures discussed above, with positive per-unit prices for <u>all</u> calls, will be welfare-superior to an optional flat rate structure. However, if measuring and billing costs can be limited to only those customers who select the measured rate, it is possible for the option of measured or flat rates to increase net welfare over a single flat rate even when a mandatory measured rate would not.

In the U.S. telephone industry different policies are developing toward measured service. The Bell System has announced its plan to offer measured service on an optional basis--giving the subscriber a choice between a flat rate and one or more measured rates. As shown in Fig. 3 AT&T's prototypical rate structure would offer the

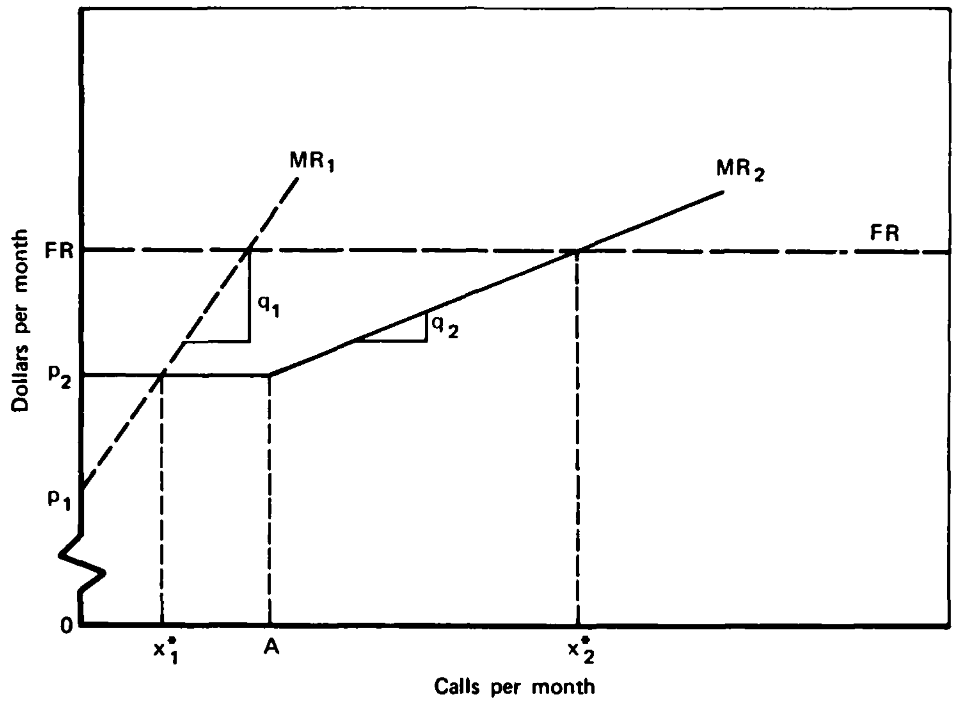

Fig. 3 — Optional rates planned by the Bell System

consumer a choice of three rate plans (Garfinkel and Linhart 1979). MR_1 would have a low access price p_1 and a substantial per call price q_1; it would be the least costly plan at very low levels of usage. MR_2 would have a higher minimum price p_2 and would provide an allowance of, for example, A = 30 calls per month, with additional calls billed at q_2 per call. High-usage consumers, making more than, for example $x_2^* = 150$ calls per month, would minimize bills by selecting the flat rate FR.* In contrast to the AT&T approach, General Telephone

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*Full-scale implementation of the AT&T rate structure would include separate charges for the initiation and duration of the call, differentiated by the distance it travels and the time of day at which it is placed.

has announced that it will convert local areas to measured service on a non-optional basis, so that all consumers will be billed under a single measured rate with no allowance (Schmidt 1979).

When flat rates and measured rates are offered as options, it is necessary to determine which consumers will select which rates in order to calculate market demands. To satisfy the budget constraint the rates must jointly recover the contribution requirement F plus all of the variable costs.

To examine the effects of optional flat and measured rates I will consider a flat rate and a single measured rate with no call allowance and assume that the new rates must satisfy the same budget constraint that applied when all customers had flat-rate service, the rate given in equation (8). Because consumers' choices of rate plans interact with the rates that can be set, the first problem is to determine what, if any, pairs of MR and FR rates are consistent with consumer choice. One can then analyze the welfare effects of optional flat and measured rates.

Equilibrium Optional Rates

It is illuminating to view the determination of equilibrium MR and FR rates as the outcome of a dynamic process. Assume, first, that there are no fixed costs or contributions to be earned by local service ($F = 0$) and that the average usage is $\bar{x}_0$ calls per month. Figure 4 shows the initial flat rate (FR_0) that recovers the marginal costs of access (C_A) and usage (C_U).

For a measured rate that covers only marginal costs (inclusive of measuring costs)

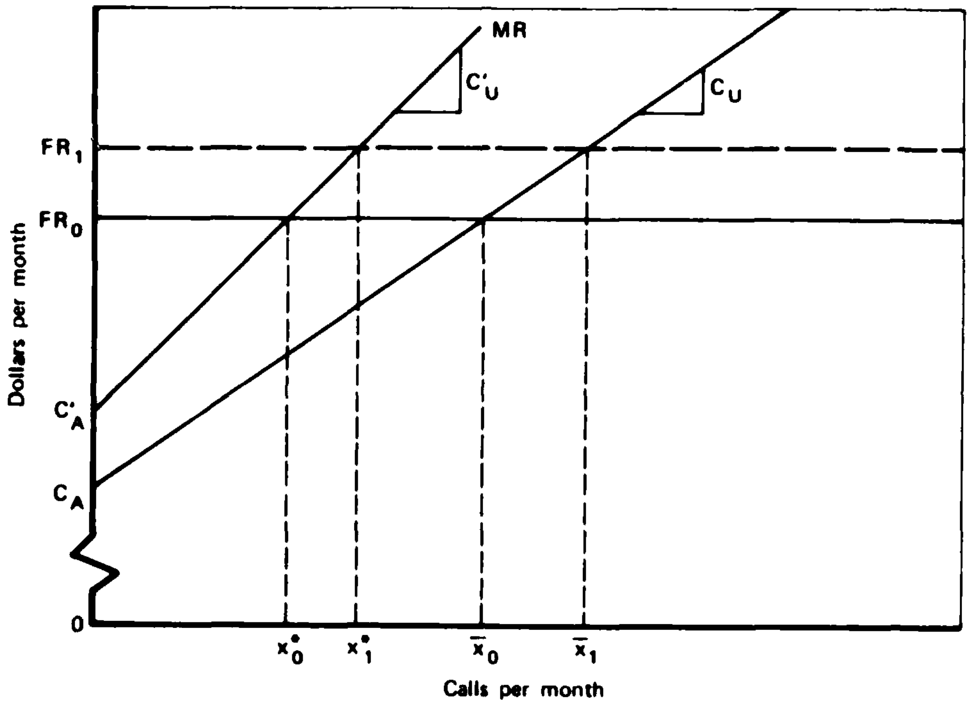

Fig. 4 — Unstable flat rate: no fixed costs and measured rate equal to marginal costs

$$MR = C'_A + C'_U x \tag{10}$$

the breakeven point--where flat and measured rates result in the same bill--occurs at x^*_0. If each consumer knows how many local calls he makes each month and if he selects his rate plan to minimize his telephone bill, then he will choose a rate plan by comparing his monthly usage to the breakeven value. A subscriber with usage $x < x^*_0$ will select the measured rate and users with $x \geq x^*_0$ will choose the flat rate.*

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*Assuming that consumers select rate plans to minimize expenditure ignores the effects of price elasticity of demand ("repression") and the resulting shift in the frequency distribution of usage when a measured rate is introduced.

In a more exact analysis each consumer would choose the plan that yields maximum surplus; this would not alter the qualitative results reached here. If the many separate decisions to place calls during

The result of this self-selection process is that the average usage of flat-rate subscribers will not be $\bar{x}_0$, but a higher value such as $\bar{x}_1$. To meet the budget constraint the initial flat rate must be raised, perhaps at the next rate hearing, to FR_1.* But now consumers with usage between x_0^* and x_1^* will select the measured rate, further increasing the average usage of the flat-rate group.

In the limiting case of zero measuring costs ($C_A' = C_A$, $C_U' = C_U$) this process continues indefinitely, and there is no equilibrium flat rate (Mitchell 1979a). However, positive measuring costs are sufficient to ensure that a (very high) equilibrium flat rate does exist.**

Suppose, however, that local telephone rates are required to generate a positive monthly contribution, $F>0$. If the measured rate covers only the marginal access, usage and measuring costs, then all of the contribution F must be raised from the subscribers choosing the flat rate. When low-usage customers ($x<x_0^*$) switch to measured service, the flat rate must now be raised by a greater amount than

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the month also contain a random component the surplus analysis becomes quite complex. A formally similar problem in the context of insurance reimbursement subject to a deductible is explored by Keeler, Newhouse and Phelps (1977).

*Panzar (1979) shows that, when demand elasticity is taken into account and consumers have strictly positive minimum usage, a measured rate with an access price exceeding marginal cost can achieve (small) welfare gains without raising the flat rate.

**Suppose that FR_1 is provisionally set equal to $C_A + C_U x_{max}$. Users between the breakeven point for this flat rate, x_1^*, and x_{max} will select the flat rate, but because their costs are each less than FR_1 a net contribution will result. Thus a slightly lower FR will both attract customers and satisfy the budget constraint.

shown in Fig. 4, in order to make up for the contributions lost from measured rate subscribers. In this case, despite the presence of measuring costs, a sizeable contribution requirement will mean that there is no stable flat rate.

However, if each measured rate customer pays more than his marginal cost it will be possible to achieve a stable flat rate. Figure 5 shows such a case, assuming for ease of illustration that consumers' usage is uniformly distributed between 0 and x_{max}. The initial flat rate is again FR_0. When the measured rate $MR = p + qx$ is offered with $p > C'_A$, $q > C'_U$, the breakeven quantity is x_0^* and consumers up this size switch to the measured rate. This shift

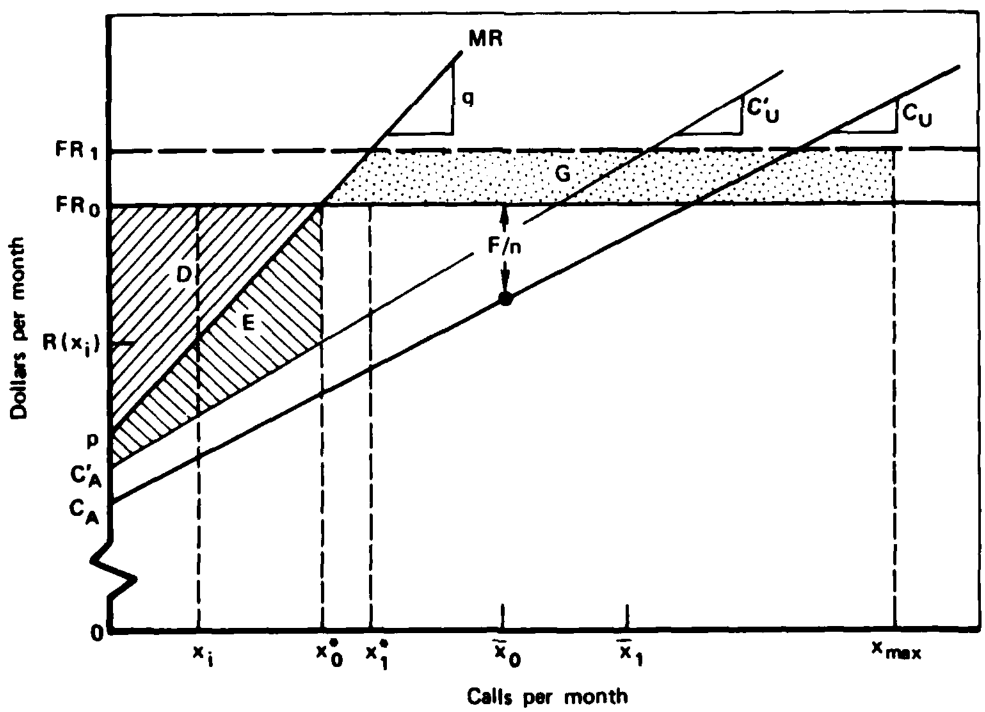

Fig. 5 — Stable flat rate: fixed costs and measured rate greater than marginal costs

reduces the ith consumer's contribution by $FR_0 - R(x_i)$. The total reduction in revenue is (proportional to) area D, although measured-rate subscribers still provide reduced contributions shown by area E. By increasing the flat rate to FR_1 the foregone contributions (area D) can be recouped from flat-rate subscribers (area G).*

This analysis demonstrates that when consumers minimize bills and local service must earn a positive contribution the optional measured rate must generally be priced above marginal costs if the flat rate is to remain viable.

Clearly there are many possible measured rate/flat rate combinations that could satisfy the budget constraint. Setting the measured rate parameters close to marginal costs will result in attracting the greatest number of customers to the measured rate; this policy will require large increases in the initial flat rate. Conversely, a measured rate well above marginal costs will be attractive to only a few small users, leaving the flat rate almost unchanged.

To narrow the choice among possible pairs of measured and flat rates one may wish to prohibit cross-subsidization between the rates. The measured rate will be subsidy-free when it covers marginal costs at each level of usage:

$$MR_i \geq C_A' + C_U' x_i \quad . \tag{11}$$

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*The higher FR_1 causes a small increase in the breakeven quantity to x_1^*. Measured consumers between x_0^* and x_1^* pay somewhat higher rates than under the original flat rate, but they also add measuring costs. The net amount has been included in the shaded area G.

For customers selecting the flat rate the corresponding requirement is that these customers as a group cover their marginal costs (Mitchell 1979a; Kahn and Zielinski 1976). Therefore, the subsidy-free condition

$$(12) \qquad FR \geq C_A + C_U\bar{x}_{FR}$$

applies to the flat-rate subscriber with average flat-rate usage $\bar{x}_{FR}$.*

Welfare Analysis

When measuring costs are so high that mandatory measured rates are undesirable, optional flat and measured rates may, nevertheless, increase welfare. This possibility arises because the measured-rate option can potentially induce new subscribers to join the network.

Suppose that the measured rate could be offered only to those consumers who were not subscribers under the initial flat rate. Because the measured rate reduces the minimum price of access it would attract some consumers unwilling to pay the flat rate to have telephone service. Any such subsidy-free measured rate would unambiguously increase welfare, because each consumer who becomes a new subscriber is better off by purchasing telephone service and is paying all of his marginal costs. Let the total welfare gain for this new group be ΔW_1.

*By estimating the mean usage of flat-rate subscribers from data samples collected in periodic traffic studies most of the costs of measuring this group's usage can be avoided.

However, xisting subscribers cannot be excluded from choosing the measured rate, so that the welfare effects on this group must also be accounted for. Existing subscribers who shift to measured service will cause new costs of measuring and billing. Facing positive per-unit prices they will also make fewer calls and thus reduce the costs of usage. If these cost savings less the value of the foregone calls were to exceed the added measuring costs, there would be a net welfare gain for this group. Let the net amount be ΔW_2. But, by hypothesis, this quantity will be negative for subscribers as a whole. A fortiori, it will be negative for the smaller users who choose the measured rate, because a portion of the costs of measuring each subscriber are invariant with usage (C_{MA}) and because low usage customers are probably less price-elastic (Park, Mitchell, and Wetzel 1980).

Finally, the addition of new subscribers to the network may increase the value of telephone service to existing subscribers. Let the total value of this externality be ΔE.* Then the overall net welfare effect of the optional flat and measured rates will be the sum of these three terms

$$\Delta W = \Delta W_1 + \Delta E + \Delta W_2 \ . \tag{13}$$

In summary, introducing a measured rate as an option to a flat rate may achieve a net gain in welfare and this gain could be achieved even if, due to the costs of measuring all subscribers, a mandatory

*The other effects of repricing from the initial FR_0 to the final MR and FR_1 only redistribute payments from one subgroup of existing subscribers to another.

measured rate would create a net loss. If measuring costs are less substantial, both optional and mandatory measured rates would increase welfare; which rate structure is welfare-optimal will depend on the magnitudes of measuring costs and demand elasticities and the distributions of consumer preferences. At sufficiently low measuring costs a mandatory rate, by imposing a positive per-unit price on all calls, would achieve the greater improvement.

At present rate levels, some 98 percent of U.S. households have access to a telephone. The potential welfare gains from adding new subscribers are, therefore, quite limited. However, elimination of the current support that local service receives from interstate toll rates could cause local flat rates to rise substantially. In these circumstances local measured rates might prevent the welfare loss that would accompany a reduction in the number of subscribers.

IMPLEMENTING A MEASURED RATE

The previous analysis is based on the assumption that each consumer chooses the rate that minimizes his monthly bill. But the available empirical evidence on consumer choices casts some doubt on the validity of that assumption.

Market Experience

A study of consumer choices in several states in which optional measured-service plans are available finds a substantial fraction of telephone subscribers are on a rate plan that results in a higher monthly bill than the minimum for their level of usage (Infosino, forthcoming). Significant numbers of subscribers take the flat rate at usage

levels well below the monthly breakeven point, and some rather high users elect measured service when the flat rate would be cheaper.* Overall, the number of customers who buy measured service is substantially smaller than the number who could reduce their telephone bills by doing do.**

The major causes of this behavior are not well understood, but several possible reasons can be advanced. Consumers lack accurate information about their telephone usage; most interview data show that they systematically overestimate the number of calls they make each month. Moreover, some consumers may be unaware that alternatives to the customary flat rate are available, or continue with a flat rate simply out of habit.

Furthermore, variation in a subscriber's calling pattern occurs because of both regular (for example, seasonal) factors and random events. Because of this variability the rate plan that minimizes the bill for a given month's usage may not be the least costly in the longer term. And consumers may prefer the assurance of a certain monthly sum to an uncertain, fluctuating one.*** A final possibility is that for this commodity--local

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*The same type of "error" is observed when three rate plans are offered.

**Somewhat paradoxically, in the one situation in which optional flat and measured-service rates are welfare optimal--relatively large measuring costs and small demand elasticities--the tendency of existing subscribers to choose the flat rate will increase welfare by reducing the measuring costs and the absolute size of ΔW_2 in (13).

***However, it is unlikely that risk aversion in the consumer's utility function can explain the observed pattern, because the amounts of expenditure at risk are in most cases very small fractions of total income.

telephone conversations--consumers have a particular dislike of paying for each item consumed. To avoid feeling "cost-conscious" when picking up the telephone to call somebody nearby such consumers are willing to pay a premium and choose the flat rate.

Ex-Post Pricing

Instead of requiring each customer to choose between a flat rate and a measured rate in advance, with the attendant uncertainty about which rate will be least costly, the telephone company could calculate the customer's bill under each plan and charge him the minimum rate for his actual usage. Such an ex-post pricing scheme would be equivalent to a single, nonlinear rate structure that is the lower envelope of the pair of optional rates.*

The disadvantage of ex-post pricing is that it requires every customer's usage to be measured. And if the expense of metering every call is to be incurred, a positive marginal price per call for all customers will be welfare-superior to charging nothing for some calls.

However, it is possible to avoid the costs of metering the customers who prefer a flat rate by offering ex-post pricing as a third option to the flat rate and the measured rate.** For example, the optional

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*In fact, this rate structure has exactly the same form as the declining-block rate plans that have been widely used for electricity sales, except that the marginal price will be zero at high levels of usage.

**This proposal is due to John Panzar.

ex-post rate (EP) could be equal to MR for usage up to the breakeven point x_1^* and thereafter equal to FR plus the costs of measuring and billing calls in excess of x_1^*. As drawn in Fig. 6, beyond x_1^* the EP rate is flat at a slightly higher level than FR. The EP rate will be subsidy-free provided that

$$
(14) \qquad \begin{array}{ll} EP \geq C'_A + C'_U x & 0 \leq x < x_1^* \\ EP \geq C'_A + C'_U \bar{x}^*_{EP} & x_1^* < x \end{array}
$$

where $\bar{x}^*_{EP}$ is the mean usage of those EP subscribers who make more than x_1^* calls per month.

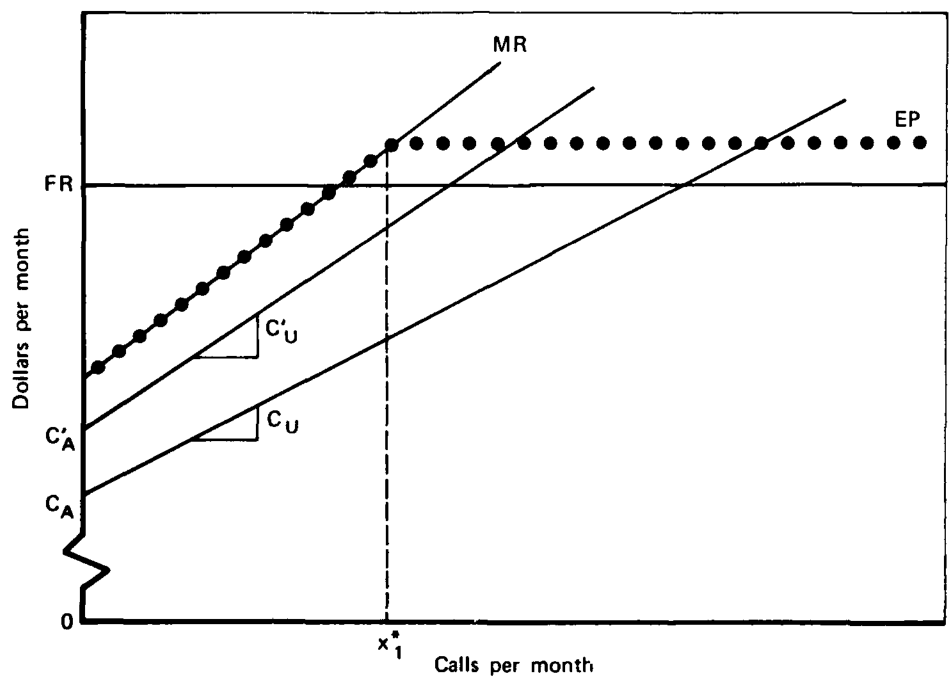

Fig. 6 — Ex-post rate as an option to flat and measured rates

In fact, if the metering process can be turned off when usage reaches x_1^*, the measuring costs of an optional EP plan might be no greater than those for the MR plan.

Consumers with high average usage and little uncertainty or monthly variability can choose FR to minimize their bills. Other consumers can select EP with the assurance that they will pay only the flat rate plus extra measuring costs if their usage lies above the breakeven level x_1^*. As drawn, the EP option dominates the MR rate, and no rational consumer would choose it. Alternatively, the telephone company might charge a premium to subscribers who select ex-post pricing. This would raise the EP schedule somewhat and make the MR rate attractive to consumers with consistently low usage.

The concept of an optional ex-post rate is readily extended to include added rate elements for the length of conversation, distance and time of day. Indeed, if consumers have difficulty in choosing the minimum-cost option when rates depend only on the number of calls, they will find optional measured-rate plans with multi-dimensional rate elements even more complex.

Evaluation

The ex-post option would constitute a market test that could discriminate between alternative explanations of consumers' observed preferences for flat-rate service. By choosing the ex-post option consumers could obtain information about their own local telephone

usage at low cost. If they presently select flat-rate service primarily because of uncertainty about what their bills would be under measured rates, then an optional ex-post rate should be popular.

However, if consumers' choices to date reflect the behavior of informed subscribers who derive utility simply from being able to place local calls at a zero price, then providing an ex-post option will not significantly increase the total number of consumers on a measured rate. In this case, the market data would provide a method of measuring the "utility premium" that subscribers attach to flat rates (Mitchell 1979c). The finding of a large premium would support the offering of optional flat-rate service on a subsidy-free basis. This approach would then be desirable even when--because measuring costs are small--mandatory measured service would otherwise be judged a welfare-superior rate structure.

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